

Message

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**From:** Jennings, Eleanor [Eleanor.Jennings@parsons.com]  
**Sent:** 6/27/2017 6:16:31 PM  
**To:** Bo [bo@praxis-enviro.com]; d'Almeida, Carolyn K. [dAlmeida.Carolyn@epa.gov]  
**CC:** Brasaemle, Karla [Karla.Brasaemle@TechLawInc.com]; Wayne Miller [Miller.Wayne@azdeq.gov]; Dan Pope [DPope@css-inc.com]; Cosler, Doug [Doug.Cosler@TechLawInc.com]; Steve Willis [steve@uxopro.com]; Davis, Eva [Davis.Eva@epa.gov]  
**Subject:** Re: Williams - ST012 - Period ending 5/12 report

I agree.

E

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**From:** Bo <bo@praxis-enviro.com>  
**Date:** June 27, 2017 at 2:00:06 PM EDT  
**To:** d'Almeida, Carolyn K. <dAlmeida.Carolyn@epa.gov>  
**Cc:** Wayne Miller <Miller.Wayne@azdeq.gov>, Steve Willis <steve@uxopro.com>, Brasaemle, Karla <Karla.Brasaemle@TechLawInc.com>, Jennings, Eleanor <Eleanor.Jennings@parsons.com>, Cosler, Doug <Doug.Cosler@TechLawInc.com>, Dan Pope <DPope@css-inc.com>, Davis, Eva <Davis.Eva@epa.gov>  
**Subject:** Re: Williams - ST012 - Period ending 5/12 report

I don't think we need to do that yet, only if they persist in trying to relate sulfate reduction to methanogenesis.

Sent from my iPhone

On Jun 26, 2017, at 11:29 AM, d'Almeida, Carolyn K. <dAlmeida.Carolyn@epa.gov> wrote:

As Eva suggested, if you want to put these new concerns on record into a memo we can forward to AF

Carolyn d'Almeida  
Remedial Project Manager  
Federal Facilities Branch (SFD 8-1)  
US EPA Region 9  
(415) 972-3150

*"Because a waste is a terrible thing to mind..."*

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**From:** Bo [mailto:Bo@praxis-enviro.com]  
**Sent:** Friday, June 23, 2017 4:24 PM  
**To:** Cosler, Doug <Doug.Cosler@TechLawInc.com>  
**Cc:** Davis, Eva <Davis.Eva@epa.gov>; Dan Pope <DPope@css-inc.com>; Jennings, Eleanor <Eleanor.Jennings@parsons.com>; d'Almeida, Carolyn K. <dAlmeida.Carolyn@epa.gov>; Wayne Miller <Miller.Wayne@azdeq.gov>; Steve Willis <steve@uxopro.com>; Brasaemle, Karla <Karla.Brasaemle@TechLawInc.com>  
**Subject:** Re: Williams - ST012 - Period ending 5/12 report

Hi Doug,

All I did was turn off Monod kinetics and use a simple, generic first order decay constant. I did not look at the mass of total napl degraded per year but I have it. I'll look at the rates but I

suspect your numbers will be matched. I suggested this methane calculation to Amec on last month's call. But it was intended to support the benefits of SVE and heat conducted upward into the vadose zone, not sulfate reduction in ground water.

Have a great weekend,

Bo

Sent from my iPhone

On Jun 23, 2017, at 3:18 PM, Cosler, Doug <[Doug.Cosler@TechLawInc.com](mailto:Doug.Cosler@TechLawInc.com)> wrote:

Bo,

Is you TOR difference for methanogenesis based on the fact that about 6 times less CO<sub>2</sub> is consumed per unit mass electron donor compared to sulfate reduction?

I don't have Bo's experience at these types of sites, but I'm still trying to understand how such a large flow rate of methane (rates extracted by SVE; equiv. to ~5,000 gal JP-4 per month) could originate in the saturated zone on a continuous basis for a year. Assuming methane solubility in the saturated UWBZ (~20 mg/L), molecular diffusion through the saturated part of the capillary fringe (say, 1 ft), and a 200x200 ft plan-view zone of contamination, only about 0.25 gal/month of "biodegraded" JP-4 fuel could pass from the saturated zone into the unsaturated zone by molecular diffusion (assuming about 1 kg of JP-4 produces about 1 kg CH<sub>4</sub> during methanogenesis). You would have to have a lot of methane microbubbles, or channeling of methane flow, continually feeding the vadose zone.

Also, how many gallons total of LNAPL were consumed during some of the EBR simulations that we forwarded to AF? The numbers I was citing in previous emails (~25 gal/month for the UWBZ and 20-yr TOR) were based on my lumped "other" hydrocarbon in my spreadsheet version of your model.

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**From:** Bo Stewart [<mailto:Bo@praxis-enviro.com>]

**Sent:** Friday, June 23, 2017 4:02 PM

**To:** Cosler, Doug <[Doug.Cosler@TechLawInc.com](mailto:Doug.Cosler@TechLawInc.com)>; 'Davis, Eva' <[Davis.Eva@epa.gov](mailto:Davis.Eva@epa.gov)>; Dan Pope <[DPope@css-inc.com](mailto:DPope@css-inc.com)>; Jennings, Eleanor <[Eleanor.Jennings@parsons.com](mailto:Eleanor.Jennings@parsons.com)>; d'Almeida, Carolyn K. <[dAlmeida.Carolyn@epa.gov](mailto:dAlmeida.Carolyn@epa.gov)>; Wayne Miller <[Miller.Wayne@azdeq.gov](mailto:Miller.Wayne@azdeq.gov)>; Steve Willis <[steve@uxopro.com](mailto:steve@uxopro.com)>

**Cc:** Brasaemle, Karla <[Karla.Brasaemle@TechLawInc.com](mailto:Karla.Brasaemle@TechLawInc.com)>

**Subject:** Re: Williams - ST012 - Period ending 5/12 report

Apologies in advance for these seemingly disconnected thoughts:

If you believe models, methanogenesis with a 5-yr half life yields a shorter time of remediation in the UWBZ than sulfate reduction at the modeled utilization rates.

I've used AFCEE guidance to calculate degradation rates at a number of SVE/bioventing operations for fuel hydrocarbons and the rates almost always "feel" higher than reality. No data to support this "feeling" even when other

sources of methane or CO2 or O2 depleters are accounted for. Hence, I shouldn't even bring this up.

My anecdotal experience with adding moderate heat (and moisture) to the vadose zone where residual JP4 resides, is a dramatic rise in methane concentrations in vapor monitoring probes.

Methane solubility decreases with temperature. Increases in the methane vapor concentration in the deep vadose zone after the start of SEE have an unknown contribution from groundwater off-gassing of methane.

My understanding is that sulfate injection will inhibit methanogenesis. But methanogenesis is currently at work in the saturated zone and enhanced by the heating from SEE. What additional steps could be taken to promote methanogenesis?

My primary concern continues to be effective treatment of the UWBZ. If the UWBZ is flooded with sulfate and SRBs are not responsive to this flooding and methanogens are inhibited in some way, then ....

Happy Friday!

On 6/23/2017 10:00 AM, Cosler, Doug wrote:

Right. And, our and AMEC's EBR modeling must be "highly incorrect" because the models account only for sulfate-reduction and the model bio rates are ~200 times too low. That is, if you believe that 50,000 gallons of JP-4 was degraded in the saturated UWBZ this past year.

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**From:** Davis, Eva [<mailto:Davis.Eva@epa.gov>]  
**Sent:** Friday, June 23, 2017 12:32 PM  
**To:** Cosler, Doug <[Doug.Cosler@TechLawInc.com](mailto:Doug.Cosler@TechLawInc.com)>; Dan Pope <[DPope@css-inc.com](mailto:DPope@css-inc.com)>; Jennings, Eleanor <[Eleanor.Jennings@parsons.com](mailto:Eleanor.Jennings@parsons.com)>; Bo Stewart <[Bo@praxis-enviro.com](mailto:Bo@praxis-enviro.com)>; d'Almeida, Carolyn K. <[dAlmeida.Carolyn@epa.gov](mailto:dAlmeida.Carolyn@epa.gov)>; Wayne Miller <[Miller.Wayne@azdeq.gov](mailto:Miller.Wayne@azdeq.gov)>; Steve Willis <[steve@uxopro.com](mailto:steve@uxopro.com)>  
**Cc:** Brasaemle, Karla <[Karla.Brasaemle@TechLawInc.com](mailto:Karla.Brasaemle@TechLawInc.com)>  
**Subject:** RE: Williams - ST012 - Period ending 5/12 report

Are you saying that if all of the methane (or a substantial part of it) is coming from the saturated zone, then they should let the methanogenesis continue rather than convert to sulfate reduction?

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**From:** Cosler, Doug [<mailto:Doug.Cosler@TechLawInc.com>]  
**Sent:** Friday, June 23, 2017 11:26 AM  
**To:** Davis, Eva <[Davis.Eva@epa.gov](mailto:Davis.Eva@epa.gov)>; Dan Pope <[DPope@css-inc.com](mailto:DPope@css-inc.com)>; Jennings, Eleanor <[Eleanor.Jennings@parsons.com](mailto:Eleanor.Jennings@parsons.com)>; Bo Stewart <[Bo@praxis-enviro.com](mailto:Bo@praxis-enviro.com)>; d'Almeida, Carolyn K. <[dAlmeida.Carolyn@epa.gov](mailto:dAlmeida.Carolyn@epa.gov)>; Wayne Miller

<Miller.Wayne@azdeq.gov>; Steve Willis <steve@uxopro.com>

**Cc:** Brasaemle, Karla <Karla.Brasaemle@TechLawInc.com>

**Subject:** RE: Williams - ST012 - Period ending 5/12 report

Eva's point below, and what Bo was getting at on the phone call, is the question: how can you differentiate methane in the unsaturated zone from unsaturated vs. saturated zone biodegradation?

Our EBR checklist and Bo's modeling is only for the saturated zone. Based on his saturated-zone modeling (AMEC's model has to be similar) the SVE methanogenesis rate (~5,000 gal/month fuel removal for 1 year) is about 250 times greater than the average saturated zone bio rate (with SRB) for a 20-yr TOR in the UWBZ (i.e., the saturated zone bio rate is <1% of AMEC's vadose zone fuel-removal values). So, our saturated zone EBR model must be way off base if we are to attribute much (>1%) of the degraded hydrocarbon mass pulled out by SVE to biodegradation in the saturated zone.

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**From:** Davis, Eva [<mailto:Davis.Eva@epa.gov>]

**Sent:** Friday, June 23, 2017 11:31 AM

**To:** Dan Pope <[DPope@css-inc.com](mailto:DPope@css-inc.com)>; Jennings, Eleanor <[Eleanor.Jennings@parsons.com](mailto:Eleanor.Jennings@parsons.com)>; Bo Stewart <[Bo@praxis-enviro.com](mailto:Bo@praxis-enviro.com)>; Cosler, Doug <[Doug.Cosler@TechLawInc.com](mailto:Doug.Cosler@TechLawInc.com)>; d'Almeida, Carolyn K. <[dAlmeida.Carolyn@epa.gov](mailto:dAlmeida.Carolyn@epa.gov)>; Wayne Miller <[Miller.Wayne@azdeq.gov](mailto:Miller.Wayne@azdeq.gov)>; Steve Willis <[steve@uxopro.com](mailto:steve@uxopro.com)>

**Cc:** Brasaemle, Karla <[Karla.Brasaemle@TechLawInc.com](mailto:Karla.Brasaemle@TechLawInc.com)>

**Subject:** RE: Williams - ST012 - Period ending 5/12 report

Didn't mean to imply that I didn't think the methane came from the jet fuel – as the CO2 would have come from the jet fuel. Was more referring to the timing of it being collected by the SVE system – which we all seem to agree we can't know for sure, but Amec is hell bent on taking credit for it happening now, and effecting the saturated zone rather than the vadose zone.

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**From:** Dan Pope [<mailto:DPope@css-inc.com>]

**Sent:** Friday, June 23, 2017 10:15 AM

**To:** Davis, Eva <[Davis.Eva@epa.gov](mailto:Davis.Eva@epa.gov)>; Jennings, Eleanor <[Eleanor.Jennings@parsons.com](mailto:Eleanor.Jennings@parsons.com)>; Bo Stewart <[Bo@praxis-enviro.com](mailto:Bo@praxis-enviro.com)>; Cosler, Doug <[Doug.Cosler@TechLawInc.com](mailto:Doug.Cosler@TechLawInc.com)>; d'Almeida, Carolyn K. <[dAlmeida.Carolyn@epa.gov](mailto:dAlmeida.Carolyn@epa.gov)>; Wayne Miller <[Miller.Wayne@azdeq.gov](mailto:Miller.Wayne@azdeq.gov)>; Steve Willis <[steve@uxopro.com](mailto:steve@uxopro.com)>

**Cc:** Brasaemle, Karla <[Karla.Brasaemle@TechLawInc.com](mailto:Karla.Brasaemle@TechLawInc.com)>

**Subject:** RE: Williams - ST012 - Period ending 5/12 report

CO2 is the electron acceptor. An electron donor, such as hydrocarbons and their breakdown products (acetate, H2, etc.), is needed in addition

to the CO<sub>2</sub> electron acceptor. So methanogenesis is indeed associated with biodegradation of hydrocarbons – in this case, jet fuel.

I suspect that the methane found at the site is a product of hydrocarbon (jet fuel) degradation. To what degree that degradation took place in the past, and is now taking place, is difficult to determine. I would be very surprised if there is no current methanogenesis taking place in the strongly anaerobic zones where there is lots of hydrocarbon.

Injection of sulfate is likely to shift the degradation balance from methanogenesis back to sulfate reduction, because sulfate reduction is more effective at harvesting energy for the microbes – therefore enabling stronger population growth of the sulfate reducers over methanogens (everything else being equal). And that's what AF wants to do.

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**From:** Davis, Eva [<mailto:Davis.Eva@epa.gov>]  
**Sent:** Friday, June 23, 2017 9:48 AM  
**To:** Jennings, Eleanor; Dan Pope; Bo Stewart; Cosler, Doug; d'Almeida, Carolyn K.; Wayne Miller; Steve Willis  
**Cc:** Brasaemle, Karla  
**Subject:** RE: Williams - ST012 - Period ending 5/12 report

So methanogenesis doesn't degrade hydrocarbons – it acts on CO<sub>2</sub>. The rate of methane generation really has nothing to do with biodegradation of the jet fuel -

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**From:** Jennings, Eleanor [<mailto:Eleanor.Jennings@parsons.com>]  
**Sent:** Friday, June 23, 2017 9:44 AM  
**To:** Davis, Eva <[Davis.Eva@epa.gov](mailto:Davis.Eva@epa.gov)>; Dan Pope <[DPope@css-inc.com](mailto:DPope@css-inc.com)>; Bo Stewart <[Bo@praxis-enviro.com](mailto:Bo@praxis-enviro.com)>; Cosler, Doug <[Doug.Cosler@TechLawInc.com](mailto:Doug.Cosler@TechLawInc.com)>; d'Almeida, Carolyn K. <[dAlmeida.Carolyn@epa.gov](mailto:dAlmeida.Carolyn@epa.gov)>; Wayne Miller <[Miller.Wayne@azdeq.gov](mailto:Miller.Wayne@azdeq.gov)>; Steve Willis <[steve@uxopro.com](mailto:steve@uxopro.com)>  
**Cc:** Brasaemle, Karla <[Karla.Brasaemle@TechLawInc.com](mailto:Karla.Brasaemle@TechLawInc.com)>  
**Subject:** RE: Williams - ST012 - Period ending 5/12 report

Hydrocarbons are broken down to CO<sub>2</sub>. Then this CO<sub>2</sub> is reduced to methane (CH<sub>4</sub>) via methanogenesis. Hydrocarbons don't go directly to methane on their own.

The same can be said for decayed plant material, and other organic material, such as seen in bogs or swamps. The material first goes to CO<sub>2</sub>, which then can be reduced to CH<sub>4</sub>.

Eleanor M. Jennings, M.S., PhD  
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[Eleanor.Jennings@Parsons.com](mailto:Eleanor.Jennings@Parsons.com)  
202.302.9996

"Safety Isn't Expensive. It's Priceless."

---

**From:** Davis, Eva [<mailto:Davis.Eva@epa.gov>]

**Sent:** Friday, June 23, 2017 10:02 AM

**To:** Dan Pope <[DPope@css-inc.com](mailto:DPope@css-inc.com)>; Jennings, Eleanor <[Eleanor.Jennings@parsons.com](mailto:Eleanor.Jennings@parsons.com)>; Bo Stewart <[Bo@praxis-enviro.com](mailto:Bo@praxis-enviro.com)>; Cosler, Doug <[Doug.Cosler@TechLawInc.com](mailto:Doug.Cosler@TechLawInc.com)>; d'Almeida, Carolyn K. <[dAlmeida.Carolyn@epa.gov](mailto:dAlmeida.Carolyn@epa.gov)>; Wayne Miller <[Miller.Wayne@azdeq.gov](mailto:Miller.Wayne@azdeq.gov)>; Steve Willis <[steve@uxopro.com](mailto:steve@uxopro.com)>

**Cc:** Brasaemle, Karla <[Karla.Brasaemle@TechLawInc.com](mailto:Karla.Brasaemle@TechLawInc.com)>

**Subject:** RE: Williams - ST012 - Period ending 5/12 report

They want to use this as an excuse to go forward with EBR without recovering more LNAPL, as Don claimed that more had degraded in the last year than they had collected as LNAPL. Thus it may be important to push back on their numbers – might want to start by trying to reproduce their numbers (they have been known to mis-calculate before). I'm no microbiologist, but I can believe the explanation that the methane was generated below the water table and trapped there until the steam injection occurred (I have seen papers talking about methane below the water table at contaminated sites where biodegradation is occurring) and I can believe that small increases in temperature around the fringes of the steam bubble caused increases in methanogenesis, mainly in the vadose zone, but a little below the water table. Both of these mechanisms for the increase would then lead to a decrease, for the first mechanism (release of old methane) the decrease would be expected to be rather short lived after steam injection is terminated, the second (increased methanogenesis due to the temperature increase) would be more gradual as either the temperature returned to ambient or the food source decreased. So it is likely that the decrease in methane capture will continue, and likely it will return to prior levels. What data we do have on benzene concentrations in groundwater since SEE was terminated show that the benzene is not going away, so it's not clear that the degradation that is occurring now is benefitting Amec/AF in their quest to remediate the site.

Stupid question time – I think of methanogenesis as taking CO<sub>2</sub> to CH<sub>4</sub> – can petroleum hydrocarbons go directly to CH<sub>4</sub> without going through CO<sub>2</sub>?

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**From:** Dan Pope [<mailto:DPope@css-inc.com>]

**Sent:** Friday, June 23, 2017 8:18 AM

**To:** Jennings, Eleanor <[Eleanor.Jennings@parsons.com](mailto:Eleanor.Jennings@parsons.com)>; Bo Stewart <[Bo@praxis-enviro.com](mailto:Bo@praxis-enviro.com)>; Cosler, Doug <[Doug.Cosler@TechLawInc.com](mailto:Doug.Cosler@TechLawInc.com)>; d'Almeida, Carolyn K. <[dAlmeida.Carolyn@epa.gov](mailto:dAlmeida.Carolyn@epa.gov)>; Davis, Eva <[Davis.Eva@epa.gov](mailto:Davis.Eva@epa.gov)>; Wayne Miller <[Miller.Wayne@azdeq.gov](mailto:Miller.Wayne@azdeq.gov)>; Steve Willis <[steve@uxopro.com](mailto:steve@uxopro.com)>

**Cc:** Brasaemle, Karla <[Karla.Brasaemle@TechLawInc.com](mailto:Karla.Brasaemle@TechLawInc.com)>

**Subject:** RE: Williams - ST012 - Period ending 5/12 report

What do we hope to achieve by confronting AF/AMEC with all our discussions/speculations about methane? That is, what are our goals, our tactics to achieve those goals, and our overall strategy?

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**From:** Jennings, Eleanor [<mailto:Eleanor.Jennings@parsons.com>]  
**Sent:** Friday, June 23, 2017 8:14 AM  
**To:** Bo Stewart; Cosler, Doug; 'd'Almeida, Carolyn K.'; Davis, Eva; Dan Pope; Wayne Miller; Steve Willis  
**Cc:** Brasaemle, Karla  
**Subject:** RE: Williams - ST012 - Period ending 5/12 report

See my responses below.....

Happy Friday, everyone!!  
E

Eleanor M. Jennings, M.S., PhD  
Principal Scientist - Environmental Microbiology and Biogeochemistry  
[Eleanor.Jennings@Parsons.com](mailto:Eleanor.Jennings@Parsons.com)  
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"Safety Isn't Expensive. It's Priceless."

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**From:** Bo Stewart [<mailto:Bo@praxis-enviro.com>]  
**Sent:** Thursday, June 22, 2017 8:03 PM  
**To:** Jennings, Eleanor <[Eleanor.Jennings@parsons.com](mailto:Eleanor.Jennings@parsons.com)>; Cosler, Doug <[Doug.Cosler@TechLawInc.com](mailto:Doug.Cosler@TechLawInc.com)>; 'd'Almeida, Carolyn K.' <[dAlmeida.Carolyn@epa.gov](mailto:dAlmeida.Carolyn@epa.gov)>; Davis, Eva <[Davis.Eva@epa.gov](mailto:Davis.Eva@epa.gov)>; Dan Pope <[DPope@css-inc.com](mailto:DPope@css-inc.com)>; Wayne Miller <[Miller.Wayne@azdeq.gov](mailto:Miller.Wayne@azdeq.gov)>; Steve Willis <[steve@uxopro.com](mailto:steve@uxopro.com)>  
**Cc:** Brasaemle, Karla <[Karla.Brasaemle@TechLawInc.com](mailto:Karla.Brasaemle@TechLawInc.com)>  
**Subject:** Re: Williams - ST012 - Period ending 5/12 report

Hold on ... we are getting into new areas of the site and need to include hydrocarbon mass and location in the equation. We have a big vadose zone with varying residual NAPL in different horizons with different mechanisms of degradation. Aerobic might be going at a much higher rate but on a smaller mass of hydrocarbon (where no methanogenesis occurs) in the middle vadose zone whereas methanogenesis occurs at a slower rate on a much larger mass of hydrocarbon in the deep vadose zone.

EMJ: OK, so although aerobic biodeg still works faster on X amount of hydrocarbon, the net amount of anaerobic/methanogenic biodegradation occurring is higher because of the higher amounts of hydrocarbons being biodegraded in the anaerobic zone as opposed to the aerobic zone. I get that, as long as the models support it. Thanks, Bo, for talking this microbiologist off of a ledge!

In addition, the residual NAPL in the middle vadose zone is at least partially tied up in finer grained, moist soils where oxygen is depleted faster than it can diffuse into this matrix. These views are consistent with the conceptual site model. Heat may not reach portions of the site undergoing aerobic degradation and therefore have no impact. The opposite for anaerobic. I've observed this following heating at several hydrocarbon sites.

Methanogenesis is increased on the fringes of the steam zone and where heat is conducted (upward in particular) rather than in the steam zone.

EMJ: This makes sense. On the fringes, it's warmer (but not too hot) and thus the methanogens have an increased metabolic rate. In the steam zone, though, it's too hot for the methanogens to live. Again, I can buy that.

It decays when steam is ceased and energy is being extracted (pulled away from previously heated zones). Also, if the water table is allowed to rise it saturates degrading hydrocarbon above and slows transport to and from this hydrocarbon. After the pilot test, the site was actively cooled by water injection and continued SVE tended to cool the deep vadose zone mitigating the enhancement to degradation.

Just a thought: I think we need to be kind of careful, though, when talking about methane. There is a big difference between active, currently-ongoing bacterial methane production (methanogenesis) and methane detection when you're out in the environment. A spike in detected methane could just mean that a pocket of long-ago-generated methane was dislodged (mechanically, or through treatments that include steam). It doesn't necessarily mean that there was a spike in current bacterial methanogenesis. This is one (of many) reasons why I like Bo's models – he was able to control "site" conditions, to account for these types of variables. If AMEC is going to use methane detection as an equivalent to current anaerobic methane generation, and then take it a step further to use methane detection as an equivalent to active, current sulfate-reduction potential (which I think they are doing), this makes the microbial-monitoring metrics in our checklist even more critical. Again, just my two cents.

On 6/22/2017 4:25 PM, Jennings, Eleanor wrote:



So hydrocarbon-degradation rates jumped up 300% during methanogenic conditions as opposed to aerobic conditions? Ummmm..... that goes against pretty much everything in the biodegradation literature. I'm assuming that this methanogenic "degradation" includes thermal breakdown?

-E

Still working on my other email (I'm trying to eat dinner at the same time, and it's not working out well....). ☺

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"Safety Isn't Expensive. It's Priceless."

---

**From:** Bo Stewart [<mailto:Bo@praxis-enviro.com>]  
**Sent:** Thursday, June 22, 2017 7:20 PM  
**To:** Jennings, Eleanor  
<[Eleanor.Jennings@parsons.com](mailto:Eleanor.Jennings@parsons.com)>; Cosler, Doug  
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**Subject:** Re: Williams - ST012 - Period ending 5/12  
report

Here are the similarly calculated rates of degradation from SVE operations starting in 2005 and through the TEE pilot test from manifold data. The SVE manifold is a mix of extraction wells including the middle vadose zone (likely aerobic) and the deep vadose zone (very likely anaerobic). Measures from individual extraction wells are available to sort out where the degradation was occurring. A similar decay in methanogenesis was observed after steam injection ceased.

To Doug's point, I refrained from going into the aqueous diffusion rate of methane compared to the vadose zone during the call. Didn't see a point in continuing to "disagree with everything." I don't

think I disagree with everything -- I think people disagree with me. I agree with field data.

On 6/22/2017 3:59 PM, Jennings, Eleanor wrote:

Yeah, but you made a point  
.... if they drew in that  
much O<sub>2</sub>, the subsurface  
would NOT be anaerobic, and  
certainly not to the degree  
to support sulfate-reducers  
or methanogens. Aerobic and  
methanogenesis are at polar-  
opposite ends of the redox  
spectrum.

E

PS: I'm working on an email  
response to the whole "we  
have methane - yeah!" issue  
as well as temperature. Hold  
on while I finish it up.....

Eleanor M. Jennings, M.S.,  
PhD

Principal Scientist -  
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"Safety Isn't  
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-----Original Message-----

From: Cosler, Doug  
[mailto:[Doug.Cosler@TechLawInc.com](mailto:Doug.Cosler@TechLawInc.com)]  
Sent: Thursday, June 22, 2017  
6:56 PM  
To: 'd'Almeida, Carolyn K.'  
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om](mailto:Karla.Brasaemle@TechLawInc.com)>  
Subject: RE: Williams - ST012  
- Period ending 5/12 report

Discard what I said about  
aerobic bio, as they  
estimated bio due to  
methanogenesis.

-----Original Message-----

From: d'Almeida, Carolyn K.  
[mailto:[dAlmeida.Carolyn@epa.  
gov](mailto:dAlmeida.Carolyn@epa.gov)]  
Sent: Thursday, June 22, 2017  
6:00 PM  
To: Davis, Eva  
<[Davis.Eva@epa.gov](mailto:Davis.Eva@epa.gov)>; Dan Pope  
<[DPope@css-inc.com](mailto:DPope@css-inc.com)>; Wayne  
Miller  
<[Miller.Wayne@azdeq.gov](mailto:Miller.Wayne@azdeq.gov)>;  
Jennings, Eleanor  
<[Eleanor.Jennings@parsons.com](mailto:Eleanor.Jennings@parsons.com)  
>; Steve Willis  
<[steve@uxopro.com](mailto:steve@uxopro.com)>; Bo  
Stewart <[Bo@Praxis-  
Enviro.com](mailto:Bo@Praxis-Enviro.com)>

Cc: Cosler, Doug  
<Doug.Cosler@TechLawInc.com>;  
Brasaemle, Karla  
<Karla.Brasaemle@TechLawInc.c  
om>

Subject: RE: Williams - ST012  
- Period ending 5/12 report

That's why they made the effort today to demonstrate how much methane they are pulling out as evidence that biodegradation is occurring. But I still think the key question is why is the trend in methane production declining from initial record right after SVE startup. Does this represent methane production from decades of biodegradation before SEE which they just now recovered, and is tapering off as it is extracted, and maybe does not reflect current biological conditions?

Carolyn d'Almeida

Remedial Project Manager

Federal Facilities Branch (SFD  
8-1)

US EPA Region 9

(415) 972-3150

"Because a waste is a  
terrible thing to mind..."

-----Original Message-----

From: Davis, Eva

Sent: Thursday, June 22, 2017  
2:31 PM

To: Dan Pope <DPope@css-  
inc.com>; d'Almeida, Carolyn  
K.  
<dAlmeida.Carolyn@epa.gov>;

Wayne Miller  
<Miller.Wayne@azdeq.gov>;  
Jennings, Eleanor  
<Eleanor.Jennings@parsons.com  
>; Steve Willis  
<steve@uxopro.com>; Bo  
Stewart <Bo@Praxis-  
Enviro.com>

Cc: Cosler, Doug  
<Doug.Cosler@TechLawInc.com>;  
Brasaemle, Karla  
<Karla.Brasaemle@TechLawInc.c  
om>

Subject: RE: Williams - ST012  
- Period ending 5/12 report

You people need to see where  
the high temperatures are in  
relation to where they plan  
on trying to treat

-----Original Message-----

From: Dan Pope  
[mailto:DPope@css-inc.com]

Sent: Thursday, June 22, 2017  
4:29 PM

To: d'Almeida, Carolyn K.  
<dAlmeida.Carolyn@epa.gov>;  
Davis, Eva  
<Davis.Eva@epa.gov>; Wayne  
Miller  
<Miller.Wayne@azdeq.gov>;  
Jennings, Eleanor  
<Eleanor.Jennings@parsons.com  
>; Steve Willis  
<steve@uxopro.com>; Bo  
Stewart <Bo@Praxis-  
Enviro.com>

Cc: Cosler, Doug  
<Doug.Cosler@TechLawInc.com>;  
Brasaemle, Karla  
<Karla.Brasaemle@TechLawInc.c  
om>

Subject: RE: Williams - ST012  
- Period ending 5/12 report

Sounds reasonable to me.

-----Original Message-----

From: d'Almeida, Carolyn K.  
[mailto:[dAlmeida.Carolyn@epa.gov](mailto:dAlmeida.Carolyn@epa.gov)]

Sent: Thursday, June 22, 2017  
4:27 PM

To: Davis, Eva; Dan Pope;  
Wayne Miller; Jennings,  
Eleanor; Steve Willis; Bo  
Stewart

Cc: Cosler, Doug; Brasaemle,  
Karla

Subject: RE: Williams - ST012  
- Period ending 5/12 report

Just a guess, but I think the concern is a 1 degree change in temp over course of day could be a stressor on the bugs that are present in that location. I suspect they realize that EBR wont be effective in the SEE treatment area because it is too hot, that's why they are focusing on the perimeter. And if they do significant extraction, the temperature redistribution will kill off the bugs that are present.

Carolyn d'Almeida

Remedial Project Manager

Federal Facilities Branch (SFD  
8-1)

US EPA Region 9

(415) 972-3150

"Because a waste is a  
terrible thing to mind..."

-----Original Message-----

From: Davis, Eva

Sent: Thursday, June 22, 2017  
2:10 PM

To: d'Almeida, Carolyn K.  
<dAlmeida.Carolyn@epa.gov>;  
Dan Pope <DPope@css-inc.com>;  
Wayne Miller  
<Miller.Wayne@azdeq.gov>;  
Jennings, Eleanor  
<Eleanor.Jennings@parsons.com  
>; Steve Willis  
<steve@uxopro.com>; Bo  
Stewart <Bo@Praxis-  
Enviro.com>

Cc: Cosler, Doug  
<Doug.Cosler@TechLawInc.com>;  
Brasaemle, Karla  
<Karla.Brasaemle@TechLawInc.c  
om>

Subject: FW: Williams - ST012  
- Period ending 5/12 report

I have a real disconnect on  
this - hope the  
microbiologists on the call  
know more about this than I  
do - they are concerned that  
a 1F/day temperature increase  
in the extraction wells could  
affect the microbial  
population, but they think  
the temps out there (see  
attached report and look at  
where the TMPs are relative  
to where they plan on  
pumping) aren't a  
problem? Can those bugs work  
at temps up to 200F?

-----Original Message-----

From: Smallbeck, Donald R.  
[mailto:Donald.Smallbeck@amec  
fw.com]

Sent: Monday, June 12, 2017  
10:06 AM

To: 'Wayne Miller'  
<Miller.Wayne@azdeq.gov>;  
d'Almeida, Carolyn K.  
<dAlmeida.Carolyn@epa.gov>

Cc: JERRARD, CATHERINE V CIV  
USAF HAF AFCEC/CIBW

<catherine.jerrard@us.af.mil>  
; Pearson, Stuart C.  
<Stuart.Pearson@amecfw.com>;  
'steve@uxopro.com'  
<steve@uxopro.com>; Davis,  
Eva <Davis.Eva@epa.gov>; d p  
<DPope@css-dynamac.com>;  
'Brasaemle, Karla'  
<KBrasaemle@TechLawInc.com>;  
Levine, Herb  
<Levine.Herb@epa.gov>

Subject: Williams - ST012 -  
Period ending 5/12 report

BCT members

Please find attached for your  
information the preliminary  
report describing ST012  
activities for the period  
from April 29 thru May 12,  
2017.

D.R. Smallbeck

Principal Program Manager

Construction Remediation

Amec Foster Wheeler

4600 E Washington Street,  
Suite 600

Phoenix, Arizona 85034

Tel: 602-733-6040

Cell: 707-480-7212

Donald.Smallbeck@amecfw.com

amecfw.com[amecfw.com]

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and/or affiliates and is



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Lloyd "Bo" Stewart, PhD, PE  
Praxis Environmental Tech., Inc.

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Lloyd "Bo" Stewart, PhD, PE  
Praxis Environmental Tech., Inc.

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Praxis Environmental Tech., Inc.